

What is claimed is:

- 1 1. A method for inspecting food products, the method comprising:
 - 2 (A) generating reference images of food products, each reference image being
 - 3 indicative of a food product of a different size, each reference image having
 - 4 optimized characteristics that are indicative of an acceptable food product, the
 - 5 optimized characteristics of each reference image comprising:
 - 6 (A1) an optimized red component;
 - 7 (A2) an optimized green component;
 - 8 (A3) an optimized blue component; and
 - 9 (A4) an optimized shape;
 - 10 (B) acquiring a sample image of a sample food product, the sample image comprising:
 - 11 (B1) a red component;
 - 12 (B2) a green component;
 - 13 (B3) a blue component;
 - 14 (B4) a sample shape; and
 - 15 (B5) a sample size;
 - 16 (C) comparing the sample size to each of the generated reference images;
 - 17 (D) selecting the reference image that is indicative of a food product having a size that
 - 18 is similar to the sample size;
 - 19 (E) generating a contrast image as a function of the selected reference image and the
 - 20 sample image, the contrast image being indicative of deviations of the sample
 - 21 image from the selected reference image, the contrast image comprising:
 - 22 (E1) a red component deviation value;
 - 23 (E2) a green component deviation value;

- 24 (E3) a blue component deviation value; and
- 25 (E4) a shape deviation value indicative; and
- 26 (F) determining an acceptability level of the sample food product, the acceptability
- 27 level being a function of:
- 28 (F1) the red component deviation value;
- 29 (F2) the green component deviation value;
- 30 (F3) the blue component deviation value; and
- 31 (F4) the shape deviation value.

- 1 2. A method for inspecting food products, the method comprising:
- 2 (A) acquiring a sample image of a sample food product, the sample image comprising:
- 3 (A1) a red component;
- 4 (A2) a green component;
- 5 (A3) a blue component;
- 6 (B) generating a reference value from the acquired sample image, the reference value
- 7 being a function of the red component, the green component, and the blue
- 8 component;
- 9 (C) generating a contrast image as a function of the reference value and the sample
- 10 image, the contrast image being indicative of deviations of the sample image from
- 11 the reference value, the contrast image comprising:
- 12 (C1) a red component deviation value;
- 13 (C2) a green component deviation value; and
- 14 (C3) a blue component deviation value; and
- 15 (D) determining an acceptability level of the sample food product, the acceptability
- 16 level being a function of:
- 17 (D1) the red component deviation value;
- 18 (D2) the green component deviation value; and
- 19 (D3) the blue component deviation value.

1 3. A method for inspecting food products, the method comprising:
2 generating reference images of food products, each reference image being
3 indicative of a food product of a different size, each reference image having optimized
4 characteristics that are indicative of an acceptable food product;
5 acquiring a sample image of a sample food product, the sample food product
6 having a sample size;
7 comparing the sample size to each of the generated reference images;
8 selecting the reference image that is indicative of a food product having a size that
9 is similar to the sample size;
10 generating a contrast image as a function of the selected reference image and the
11 sample image, the contrast image being indicative of deviations of the sample image from
12 the selected reference image; and
13 determining an acceptability level of the sample food product from the generated
14 contrast image.

1 4. A method for inspecting food products, the method comprising:
2 acquiring a sample image of a sample food product;
3 generating a reference value from the acquired sample image;
4 generating a contrast image as a function of the reference value and the sample
5 image, the contrast image being indicative of deviations of the sample image from the
6 reference value;
7 determining an acceptability level of the sample food product from the generated
8 contrast image.

1 5. A method for extracting image features, the method comprising:
2 providing reference data having reference features;
3 acquiring image data;
4 generating contrast data as a function of the reference data and the image data;
5 performing a clustering algorithm on the contrast data to generate clusters of
6 contrast data; and
7 identifying features from the clusters of contrast data.

1 6. A method for detecting defects in products, the method comprising:
2 providing reference data having reference features, the reference features
3 representing features of an optimized product;
4 acquiring sample data having sample features, the sample features representing
5 features of a sample product, each of the sample features corresponding to one of the
6 reference features;
7 generating contrast data as a function of the reference data and the sample data,
8 the contrast data having contrast features, the contrast features representing deviations
9 between the sample features and the reference features; and
10 determining an acceptability level of the sample product from the generated
11 contrast data.

1 7. The method of claim 6, further comprising:
2 discarding the sample product in response to determining that the acceptability
3 level of the sample product is below an acceptable threshold level.

1 8. The method of claim 6, further comprising:
2 retaining the sample product in response to determining that the acceptability level
3 of the sample product is not below an acceptable threshold level.

1 9. The method of claim 6, wherein the step of acquiring the sample data
2 comprises:
3 acquiring an image of a food product.

1 10. The method of claim 6, wherein the food product is selected from a group
2 consisting of:
3 meats;
4 grains
5 vegetables;
6 fruits;
7 legumes; and
8 processed food items.

1 11. The method of claim 6, wherein the step of providing the reference data
2 comprises:
3 acquiring an image of the optimized product, the example product having minimal
4 defects; and
5 storing the acquired image.

1 12. The method of claim 6, wherein the step of providing the reference data
2 comprises:

3 evaluating data points within the sample data;
4 calculating the mode of the data points; and
5 storing the mode.

1 13. The method of claim 6, wherein the step of providing the reference data
2 comprises:

3 evaluating data points within the sample data;
4 calculating the mean of the data points; and
5 storing the mean.

1 14. The method of claim 6, wherein the step of providing the reference data
2 comprises:
3 updating a reference value of a current sample with a reference value of a previous
4 sample.

1 15. The method of claim 6, wherein the step of generating the contrast data
2 comprises:
3 determining a difference between the reference data and the sample data to
4 generate difference data.

1 16. The method of claim 15, wherein the step of determining the difference
2 comprises:

3 extracting spectral components from the reference data;

4 extracting spectral components from the sample data, each of the spectral
5 components of the sample data corresponding to one of the spectral components of the
6 reference data; and

7 determining the difference between a spectral component from the reference data
8 and a corresponding spectral component from the sample data.

1 17. The method of claim 16, wherein the step of extracting the spectral
2 components from the reference data comprises a step selected from the group consisting
3 of:

4 extracting a red component from the reference data;

5 extracting a green component from the reference data; and

6 extracting a blue component from the reference data.

1 18. The method of claim 16, wherein the step of extracting the spectral
2 components from the sample data comprises a step selected from the group consisting of:

3 extracting a red component from the sample data;

4 extracting a green component from the sample data; and

5 extracting a blue component from the sample data.

1 19. The method of claim 15, further comprising:

2 normalizing the difference data to the reference data.

1 20. The method of claim 6, wherein the step of determining the acceptability
2 level comprises:
3 clustering the contrast features into predetermined cluster groups, each cluster
4 group corresponding to a contrast feature; and
5 evaluating the size of each cluster group to quantitatively determine the amount of
6 each contrast feature.

1 21. The method of claim 20, wherein at least one of the cluster groups
2 corresponds to a defect feature.

1 22. The method of claim 6, further comprising:
2 updating the reference data with information gathered from the sample data.

1 23. A system for detecting defects in products, the system comprising:
2 reference data having reference features, the reference features representing
3 features of an optimized product;
4 sample data having sample features, the sample features representing features of a
5 sample product, each of the sample features corresponding to one of the reference
6 features;
7 logic configured to generate contrast data as a function of the reference data and
8 the sample data, the contrast data having contrast features, the contrast features
9 representing deviations between the sample features and the reference features; and
10 logic configured to determine an acceptability level of the sample product from
11 the generated contrast data.

1 24. The system of claim 23, wherein the step of acquiring the sample data
2 comprises:
3 means for acquiring an image of a food product.

1 25. The system of claim 23, wherein the step of acquiring the sample data
2 comprises:
3 logic configured to acquire an image of a food product.

1 26. The system of claim 23, wherein the food product is selected from a group
2 consisting of:
3 meats;
4 grains
5 vegetables;
6 fruits;
7 legumes; and
8 processed food items.